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***ON THE VALUE OF CHEAP MICROSCOPES FOR EDUCATIONAL PURPOSES.***

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The quality of a microscope presents itself in different lights to the specialist and to the ordinary scholar. While the former needs and, if able, is willing to pay for all that the maker can add to the instrument to increase its accuracy and delicacy, the latter is glad in many, I may say in most, cases to possess any reasonably good compound microscope. Most high-school scholars and college students are unable to afford the money necessary for purchasing a microscope at the end of their educational course and consequently drop their studies in biology and never afterwards resume them. Any interest that was felt in the work gradually fades away and the young microscopist, perhaps a promising one, is lost.

The improved trend of modern scientific education strongly accentuates this difficulty for the young worker. Book-work as a means of learning is not the accepted method. Experiment and observation are relied on, not to the exclusion of but in supremacy over all other modes of learning. The microscope has consequently assumed a position second to no instrument of education in science, and familiarity with this instrument and facility in its use and in the interpretation of its revelations are indispensable "first steps" in scientific education. A certain amount of this is attained at college and by the use of the college microscopes, but this is only a minimum. It moreover lacks the important element of voluntary action. But if the student owns his own instrument and can take it out for a few minutes whenever he wishes he will surely educate himself in science as he can do in no other way.

The earnest and thoughtful teacher also seeks less to cram than to develop the faculties, and is better satisfied if his pupil leaves him with a relish for the study than if he leaves him loaded with information but indifferent to further advance.

Hence comes the desirability that there should be in the market an instrument of fair quality, destitute of all refinement that can be dispensed with, and possessing only the absolutely necessary powers and facilities for ordinary work. No very high objectives can be put on such a microscope. A quarter-inch with good defining power, long working distance, and moderate aperture is best for the purpose. If separable, greater variety can be attained. A second objective of one inch and, if separable, giving also a one and a half inch focal length should also be included. A rack-and-pinion coarse adjustment and a screw fine adjustment are also, I think, equally necessary for successful working.

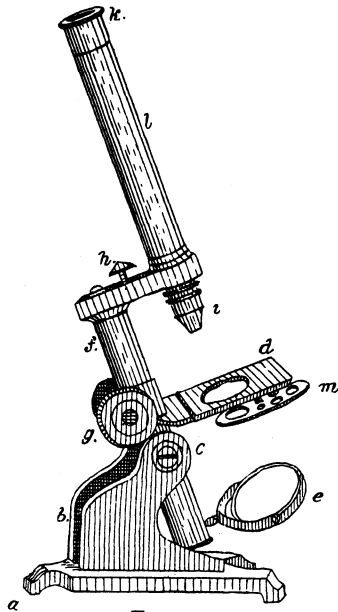
All or nearly all these are contained in several microscopes that have long been in the European market, and have enabled students to supply themselves with instruments during and after their college course and so to continue their studies. Fifteen dollars will there provide a young man or woman with an outfit abundantly sufficient for all the purposes required for many years and in most cases for life. Such a microscope is far indeed from being perfect, and it would be easy to criticise and condemn some parts; but on the principle that half a loaf is better than no bread, an inferior instrument is infinitely better than none.

This statement will doubtless be disputed by some, especially among those who have been accustomed to use the multitudinous modern additions to the microscope; but it is notorious that in many, if not in most, of the sciences a vast amount, and in some cases the greater part, of the results now attained have been won by observers possessing only second or third rate instruments. It is not the telescope or the microscope or the camera that does the work, but the man or the woman who uses it; and a student with power, patience, and perseverance will often accomplish much by the use of a small and cheap microscope in the education of his own faculties, and may even make important discoveries, when without it his interest would flag and he would desert the ranks of science altogether.

The class of European microscopes here referred to have been of infinite service in the past to the rising generation of students, and it seems as if the time had come when American makers, with the enormous advantage which they possess in the extensive use of machinery, should be able, if they will only turn their attention seriously to the subject, to nearly countervail the disadvantage of dearer labor and to put on the market a better microscope than any

of those to which I here refer and at a price not greatly exceeding them.

Every microscopist knows that the ownership of an instrument is indispensable to good and continuous work, and that the popularization of knowledge in his favorite department is second only to its discovery. Were such microscopes as I have here mentioned attainable by the earnest but often impecunious student, whether in or outside of college, a great impetus would be given to individual work, and the members of that class from which the ranks of this Society are recruited would be largely increased.



*Fig. 5*

The microscope referred to by Professor Claypole was made by Field & Co., of Birmingham, England, as the result of a competition for the medal of the Society of Arts, January, 1855. Two medals were offered, one for a "school," the other for a teacher's or student's microscope. The first was to cost 10s. 6d.; the second £3. 3s., and to be compound achromatic, having two eyepieces and two objectives, magnifying 25 and 120 respectively with lowest eyepiece. In making comparisons between American and foreign instruments as regards price, the stands and the objectives should be compared separately. The above cut is from Notcutt's Handbook, 1859.—W. H. S.